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Semi-fermionic approach for quantum spin systems*

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We discuss a new path-integral semi-fermionic approach † for quantum spin systems in application to the Kondo Lattice model in the vicinity of magnetic or spin-glass transition. Based on the exact representation of the local spins as a bilinear combination of Fermi operators with imaginary chemical potential, the method provides an exact treatment of the local constraint. We analyze the interplay between the inter-site magnetic correlations and Kondo effect for the case of competing RKKY and Kondo interactions. We present a new revisited Doniach phase diagram for two different cases of clean and disordered magnets. The Schwinger-Keldysh real-time formalism based on the semi-fermionic representation is applied to describe the spin liquids being out of equilibrium and nonequilibrium Kondo systems.

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